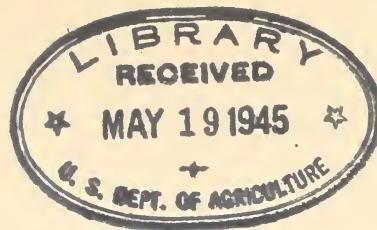


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B. T. GALLOWAY, Chief of Bureau.

THE PRESENT STATUS OF THE WHITE- PINE BLIGHTS.

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THE PRESENT STATUS OF THE WHITE-PINE BLIGHTS.^a

INTRODUCTION.

During the past four or five years there have been many complaints from owners of timber lands concerning a blight of white pine (*Pinus strobus* L.). These complaints began in 1904 and have become increasingly frequent ever since. While there is some foundation for alarm it is undoubtedly true that the same amount of damage fifteen years ago would hardly have excited comment. The price of timber has advanced during this period and people generally are becoming aware that a timber shortage is imminent.

The original stand of white-pine trees is exhausted and the lumber trade can depend only on the scrubby second growth, which is usually less than 75 years of age. This has led to the planting of young trees in very considerable quantities, in the hope of supplying the future more urgent demand at an adequate profit on the investment. The handling of the young trees either in the nursery or in the permanent plantation has led to a much more intelligent and careful consideration of the factors controlling the growth and life of this species than was the case only a few years since. However, much is yet to be accomplished in this regard, not only with the white pine but with many other less esteemed species of our forest trees.

^a This circular presents the results of investigations on the white-pine blight to date. It shows that there are several distinct diseases due to as many different causes. Comparatively few trees have been killed and timber owners should not become unduly alarmed, as the trees have in many cases already partially recovered from the blight. At present there is absolutely no reason known for cutting or disposing of thrifty young white-pine forests in which are scattering trees affected with the blight in any of its forms; nor should work upon proposed plantations of this species be relinquished or postponed from fear of this trouble. Studies on the relation of insects to twig-blight have been carried on by Dr. A. D. Hopkins, of the Bureau of Entomology, and his assistants. The writer and Doctor Hopkins have also made some cooperative studies in the field.—B. T. GALLOWAY, *Chief of Bureau.*

HISTORY OF THE DIFFERENT FORMS OF BLIGHT.

Specimens of diseased twigs were referred to the Bureau of Plant Industry at various times before the writer took up the problem. The correspondence shows that a number of fungi were found on the dead leaves, the more common ones being *Septoria spadicea* Patterson and Charles,^a *Hendersonia foliicola* (Berk.) Fckl., *Lophodermium pinastri* (Shrad.) Cher., *L. brachysporum* Rostr., and *Pestalozzia funerea* Desm.

In 1907 the complaints were renewed with increasing insistence and specimens of affected leaves and twigs were received from many sections of New York and New England. Accordingly, in August, 1907, the writer was detailed to study the problem carefully. Examination of the specimens of diseased leaves showed that the fungus *Septoria spadicea* Patterson and Charles practically always accompanied the disease. In November, 1907, plots of labeled trees were established at Westbury (Long Island), N. Y.; Windsor, Conn.; Brunswick, Me.; Exeter and Nashua, N. H.; and Burlington, Vt. Each tree was given a number, and one hundred or more trees were included in each plot, except the one at Windsor, Conn., where there were but fifty. Later, the plot at Exeter, N. H., was discontinued, so that finally 600 trees were kept under observation. At various times careful notes have been made on the condition of the foliage of these trees, thus furnishing a history of the progress of the disease on the labeled trees.

COMPLEX NATURE OF THE DISEASED CONDITION.

At the very outset it was recognized that there was more than one disease which was included in the term "white-pine blight," and this has become increasingly evident with the further progress of the investigations. In 1907 the disease discussed later in this circular under the name "leaf-blight" was by far the most common one and was usually the one referred to by correspondents and forest owners; but there was also found a twig-blight caused by *Lophodermium brachysporum* Rostr. which was fairly common, though not noticeable in destructive effects. Some cases were also noted where winter-killing might have occurred, though this could not be definitely ascertained.

^a This fungus has been confused with *Septoria parasitica* Hartig, but is quite distinct. A technical description by Mrs. Flora W. Patterson and Miss Vera K. Charles follows: *Septoria spadicea* Patterson and Charles.

Pyrenidia not spot forming, late becoming slightly erumpent on inner surface of browning needles, scattered, membranous, fuscous-olivaceous, submersed, 190-225 μ in diameter. Spores hyaline, cylindrical, slightly curved or flexuous, apex acute, one septate, rarely constricted at septum, 3-4 \times 30-45 μ . Basidia short.

On leaves of *Pinus strobus*.

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In 1908 a still greater diversity of forms of disease was found and, in some sections at least, the leaf-blight which had been so prevalent the preceding season was not the disease which was then arousing attention. The leaf-blight was less prevalent and apparently much less virulent than in 1907,^a although it still had about the same distribution. The trouble which attracted attention in most localities, however, was a twig-blight and not the leaf-blight. Examinations made in New York and New England showed that this twig-blight was caused by several distinct factors. One type of this blight was found to be largely localized on one side of the affected trees, and it was concluded that this was a case of true winterkilling.^b Studies made by the pathologist of the Maine Agricultural Experiment Station^c seem to show that much of the blight in Maine was due to winter-killing. This was not true of all sections, however. Besides the several forms of blight already mentioned, an additional one appeared in certain localities which is apparently caused by insects.

LEAF-BLIGHT.

DESCRIPTION OF LEAF-BLIGHT.

Leaf-blight is characterized by the death of the apical portion of the leaf, commonly for a fourth or a third of the entire length of the leaf, but in extreme cases finally extending to the base and causing the premature fall of the deadened leaves.

When first attacked, the color of the dead parts is bright reddish brown, different from the color assumed in any other disease known to the writer. It is at this stage that the disease attracts the most attention, as the reddish color shows conspicuously against the dark green of the healthy trees. In two or three months the color fades to a dull brownish gray, at which stage it is quite difficult to distinguish the diseased trees from the healthy ones at a little distance. This change in color gives the impression that the trees have partially recovered from the trouble unless a close examination is made. The dead portions sometimes break off during the winter, but are usually intact the next spring and summer.

The leaves of the diseased tree may be of normal length, or they may be much shorter than normal, and the same variations occur in the length of the leaves of unaffected trees, i. e., the blight seems to have no relation to the length of the leaves except in the last stages of the disease, when the leaves are very short.

^a Dana, S. T. Unnumbered circular of U. S. Forest Service on "Extent and Importance of the White Pine Blight," pp. 1-4. 1908.

^b Galloway, B. T. Report, Chief of Bureau of Plant Industry, p. 21. 1908.

^c Morse, W. J. Report, Maine Forest Commission, vol. 7, pp. 20-25, 1908, and Bulletin 164, Maine Agricultural Experiment Station, pp. 21-28, 1909.

The white pine ordinarily sheds its leaves in their second autumn,^a although it is not uncommon for them to persist until the third summer and autumn. Usually the tree has but two sets of leaves and one or both may be affected with the leaf-blight. The disease may affect the whole crown or only a portion of it. Usually the blight is generally distributed throughout the entire crown of the tree, but many cases occur where the upper part is diseased while the lower branches are healthy. On the contrary, the blight sometimes affects the lower branches and the upper part of the crown is still healthy, but single diseased branches scattered here and there among the healthy ones never occur with this trouble.

The leaf-blight has been observed by the writer on trees of all ages, from four years upward. It attacks young and old almost indifferently when the comparative numbers of each are considered. Trees in thick stands are apparently as likely to be affected as those standing in the open. As already indicated, an affected tree is apt to be generally diseased in all parts of its crown. Such trees are usually found singly or in twos or threes among their fellows and often healthy and affected trees in all stages of disease stand side by side, and even with their bases grown together. But forked trees may or may not have both parts diseased.

The disease appears on the new leaves about the time they reach full length, beginning in 1907 and 1908 about July 1. It attacks the leaves only during their first summer.

DISTRIBUTION OF LEAF-BLIGHT.

The leaf-blight is known to extend from the southern part of Maine and northern New Hampshire and Vermont to the Hudson Valley in New York, central Pennsylvania, and along the Alleghenies to western North Carolina. Whether it occurs in the western portion of the white-pine region is as yet uncertain. In the sections where it is present it is distributed locally, there being areas free from it, while other areas are seriously infested. It apparently does not occur at the higher altitudes in the north, as it has not yet been found in the Adirondacks, where white pine is fairly common and is being planted in large areas.

POSSIBLE CAUSES OF LEAF-BLIGHT.

Dry weather, resulting in an insufficient supply of water in early summer, would seem to cause the death of leaves in this manner, but observations seem to show that this can not be the cause of the leaf-blight. A tree about 20 inches in diameter and which is in good condition otherwise, standing beside a reservoir of water which has not

^a Sargent, C. S. Manual of Trees of North America, p. 4. 1905.
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been empty for the last fifteen years, is nevertheless affected generally throughout the top with leaf-blight. Other similarly situated trees in other localities show the same condition.

Winter injury is still an unsettled question. It would seem that trees which were affected by winterkilling in the roots during the last two or three winters would show the effects more plainly during the past extremely dry summer (1908), rather than a partial recovery, as was actually the case with 50 per cent of the diseased trees which have been under careful observation. In other words, the affected trees have been recovering during the driest summer that has been experienced for many years. There is another form of winter injury which is essentially a drying out of the tissue due to continued transpiration from the leaves when the soil and roots are frozen. This is a common cause of death of conifers in the Great Plains region of the West and has affected the white pine in certain districts of the East, as has been stated in other parts of this circular.

The late freeze in the spring of 1907 might have killed the tips of the leaves of the white pine, but growth at that time was hardly more than begun. Moreover, observations made by the writer upon the freeze of June 3, 1908, showed that the white pine was not injured in the Adirondacks, although other native trees were frozen and immediately showed the effects of freezing. The white pine was conspicuously free from leaf-blight throughout the season, as it always has been in the Adirondack region, where both early and late frosts are very prevalent.

Sun-scald would affect the tree top more or less locally on one side, as is described by Stewart^a as occurring on cherry, and by Stone and Smith^b on sugar maple, whereas such is not the case. The disease occurs generally throughout the tree top or in the entire upper or lower portion of the top; the leaf-blight is not localized on one side of the tree. However, the leaf-blight appears at the time when sun-scald would seem to be most likely to affect the white pine—just as the new leaves reach their full length.

Injurious gases can hardly be the cause of leaf-blight, as the disease occurs in localities far from any considerable source of smoke or sulphur gases.

Aeration can have nothing to do with the death of the tips of leaves, as the disease occurs on trees in open ground, as well as on those in close stands where there is a thick layer of dead needles covering the roots.

^a Stewart, F. C. Bulletin 162, New York (Geneva) Agricultural Experiment Station, pp. 171-178. 1899.

^b Stone, G. E., and Smith, R. E. Report 9, Massachusetts (Hatch) Agricultural Experiment Station, pp. 81-82. 1897.

Root-rot can not apparently produce such a trouble as leaf-blight, as a considerable number of white-pine trees have been examined by the writer which had their roots largely killed by *Fomes annosus* (Fr.) Cke., but their leaves were green for their whole length, and in fact showed no disease, although the roots were so badly rotted that the trees were blown over. Clinton ^a has described diseased trees which had a fungus on the roots, but he was uncertain whether the fungus killed the roots or not. In this case the tree top died downward gradually.

As before mentioned, a number of fungi have been found fruiting on the needles affected with leaf-blight. These are *Septoria spadicea* Patterson and Charles, *Hendersonia foliicola* (Berk.) Fckl., *Pestalozzia funerea* Desm., and a number of others which are known to occur only on dead tissues. Of all these only the first has been found occurring at all regularly on the diseased parts. Inoculations have been made by the writer on young white pines in the greenhouse, but no infection resulted. This proves nothing, as the leaves of the inoculated plants were not young and newly grown, which condition may be necessary for the attack of the fungus. Also, other conditions necessary for the growth of the fungus might not have been obtained in the experiments. *Septoria spadicea* Patterson and Charles has not been found so generally accompanying the disease in 1908 as was the case in 1907, but this may possibly be explained by the extremely dry season of 1908, which might have hindered the development of fruiting bodies.

It is impossible to definitely state what is the primary cause of the leaf-blight, but it probably is closely connected with extreme climatic conditions which have prevailed during the past few winters.

During the past two years there has been considerable mention of a disease of larch and *Abies pectinata* in Scandinavia and France. This disease was characterized by the reddening and ultimate death of the leaves quite generally throughout the top of the affected tree. A number of different fungi have been found by various investigators associated with the disease, but proof of their parasitic character was in most cases not obtained. The outbreak simultaneously in Europe and America of a somewhat similar disease on closely related trees is at least interesting, and it is barely possible that they are both primarily due to extreme weather conditions, which are not thoroughly understood at present in either locality.

RESULTS OF INVESTIGATIONS OF LEAF-BLIGHT.

The leaf-blight has been known for a number of years and several wood-lot owners say they have known it for ten or more years. The outbreaks usually begin about July 1 and vary in intensity from year

^a Clinton, G. P. Report, Connecticut State Botanist for 1906, pp. 320-321.

to year, that of 1907 being especially bad, while in 1908 it was much less serious.

The leaf-blight may cause the death of affected trees. In a few instances it has been known to do so in a single season, but it usually takes two or more seasons. Even in the worst affected districts the number of trees killed is relatively small, so the damage is one that is negligible, for the present at least. Our records show that the disease was much less virulent in 1908 than in 1907; that no new trees became affected in 1908; that many of the trees that were affected in 1907 were also diseased in 1908; and that 50 per cent which were diseased in 1907 did not have their 1908 leaves affected and are thus showing a partial recovery from the trouble. The status of the trouble is generally much more encouraging than it was in 1907.

TWIG-BLIGHT.

In 1907 the leaf-blight previously described was found to be the prevalent white-pine disease, but this was not the case generally in 1908. Except in localities where the leaf-blight had been most prevalent in the preceding season a twig-blight was found to be most common in 1908. It was also found that there were several different forms or types of twig-blight, apparently caused by as many different factors.

TWIG-BLIGHT CAUSED BY WINTERKILLING.

One form of twig-blight in which the injury was usually limited to the north and west sides of the trees, while the opposite sides were uninjured,^a was prevalent in Maine. Sometimes the entire tree was affected, but this was rather uncommon. This blight affected only small trees, usually less than 10 or 15 feet in height, while large trees were seldom or only slightly blighted. All the indications seemed to show that this was a real winter injury, caused by excessive transpiration of water from the leaves while the roots were frozen solidly in the earth. The leaf tissues were thus drained of their necessary water content without being able to replace it from the roots and of course died from lack of water. Aside from the relatively small number of trees which were entirely killed the damage was very slight, amounting at most to a setback in growth for a year or possibly two years.

TWIG-BLIGHT CAUSED BY INSECTS.

Another twig-blight was studied more especially in New Hampshire by the Bureau of Entomology of the Department of Agriculture. It was characterized by the wilting and death of the previous year's

^a Morse, W. J. Report, Maine Forest Commission, vol. 7, pp. 20-25, 1908, and Bulletin 164, Maine Agricultural Experiment Station, pp. 21-28, 1909.

growth on the lateral branches on all sides of the trees in April and May, 1908. The leader or central shoot was very rarely affected. This type of twig-blight was apparently caused by insects, and is mentioned here to differentiate it from the other forms of blight. This blight was found in the more northern part of Maine also, but not in the belt of lower altitude, including the well-settled region near the coast, where the winterkilling previously mentioned seemed to be especially prevalent.

TWIG-BLIGHT CAUSED BY *LOPHODERMUM BRACHYSPORUM*.

The twig-blight caused by *Lophodermum brachysporum* Rostr. was noted more especially at Brunswick, Me., in a small tract of young trees from 1 to about 10 feet in height which was located on the edge of an older stand and thus at a disadvantage by being overshadowed. Here some damage was done, a considerable number of the young trees being killed outright. The disease was also noted on the lower branches of older trees, not only at Brunswick but also sparingly at a number of other stations.

SENSITIVE NATURE OF THE WHITE PINE.

Among all our native forest trees the young white pine is especially liable to serious and permanent injury from wounds which are almost of a trivial nature. If a branch or young tree becomes sharply bent without any external indications of breakage it is almost sure to die from the effects of the undue strain. Many trees which have a comparatively small wound, extending less than one-third the circumference of the stem, die from the effects of such wounds. This is especially true of small trees. The white pine, too, is said to be particularly susceptible to injury from poisonous gases and smoke.^a These statements must not be taken as an argument against planting the white pine, as its many valuable properties far outweigh any sensitiveness to injury while young.

DEATH OF WHITE-PINE TREES FROM OTHER CAUSES THAN BLIGHT.

COMPETITION.

In any fairly dense stand of trees it is inevitable that some of them will die unless thinning is properly done; it is perfectly natural that some should die from various causes. The most potent factor in the death of such trees is competition among the trees themselves. There is a very keen competition among the roots for food, water, and space in the soil. There is an equally sharp competition among the

^a Schrenk, Hermann von, and Spaulding, Perley. Bulletin 149, Bureau of Plant Industry. 1909.

terminal shoots and lateral branches for light and sunshine, which results in the most vigorous trees gaining the lead and keeping slightly ahead ever after if no accident happens to prevent. This results in the weaker trees being placed at a constantly increasing disadvantage, and finally being crowded out of the race, suppressed, and ultimately killed.

INSECTS.

It has been shown by the entomologists that insects are responsible for the death of trees of all ages and that they often cause injuries to the leaves, twigs, and branches which are of more or less serious consequence. There are also certain troubles affecting the living trees in which it is very difficult to determine whether or not insects or fungi are the primary cause or whether it is a combination of factors, including insects, diseases, climate, etc.

ROOT-ROT.

There are several different fungi which cause root-rot and it is by no means an uncommon thing to find trees killed in this way. The two fungi which are found most commonly causing root-rot are *Armillaria mellea* (Vahl.) Quel. and *Fomes annosus* (Fr.) Cke.

LIGHTNING.

Lightning also kills scattered trees and groups of trees, and the loss from this source may not be as insignificant as it is now supposed to be.

CAUTION.

All of the factors mentioned—competition among the trees for food, water, etc.; injuries caused by insects, root-rot, and lightning—are constantly causing the death of white-pine trees, and the timber owner must be careful not to come to the conclusion that all dead trees are caused by the blight. The blight does kill trees, but the damage thus far caused by it is not great, and apparently will not become a serious matter in most localities.

CONCLUSIONS.

The white-pine blight is a complex of several different diseases.

The leaf-blight is the disease which has persisted longest in many localities. Its cause is as yet undetermined. It was much less prevalent in 1908 than in 1907 and many affected trees have partially recovered, while no new ones became diseased. This is believed to be the most important form of blight.

The twig-blight caused by *Lophodermium* may occur another season if the weather is especially favorable for the fungus, but serious

damage from this disease is not at all common. The other twig-brights are transitory in character and have thus far caused no permanent damage. Any or all of them may not occur again in the next ten years, and they may recur within one or two years, though this is not likely. The total damage caused by the blight is comparatively slight, only scattering trees having yet been killed. Trees die constantly from the effect of competition among themselves, from the attacks of insects, from root-rot, and from lightning, and the timber owner must be careful not to confuse trees killed in this way with those killed by the blight.

Those trees which are so badly diseased as to be unable to recover ought to be cut and utilized, for the same reasons that any dying tree should be removed from the forest. There is absolutely no reason known at present for cutting trees that are able to recover or that are healthy.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., June 8, 1909.

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